

High bandwidth access on cable

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Dream it. Live it.™ 

COM21

- Founded in 95, IPO 98
- 2000 Sales : 200 M Euros
- 160 employes :
 - Milpitas Headquarters
 - Development center in Cork
 - Implantations Paris, Rennes, Hollande, Allemagne, Espagne
- Core business : access systems for cable.
- 4-5th worldwide



Agenda

- Cable – DSL market
- Traffic scenarios
- Network architecture solutions
- Telephony over cable
- QoS
- security
- Conclusion



Healthy market for broadband

- Room for mix of different broadband technologies
 - **By 2006, 96 million users will have ADSL or cable modems (Source: Ovum, 2001)**
 - **Demand for broadband still increasing with the Asia-Pacific region (expected to represent 40%)**
- Cable potential ;
 - **No. of homes passed by cable represents the whole potential target market of cable operators.**
 - **% of homes passed very high for some countries (Benelux, Asia Pacific..) - market forecasts very healthy for these countries alone**

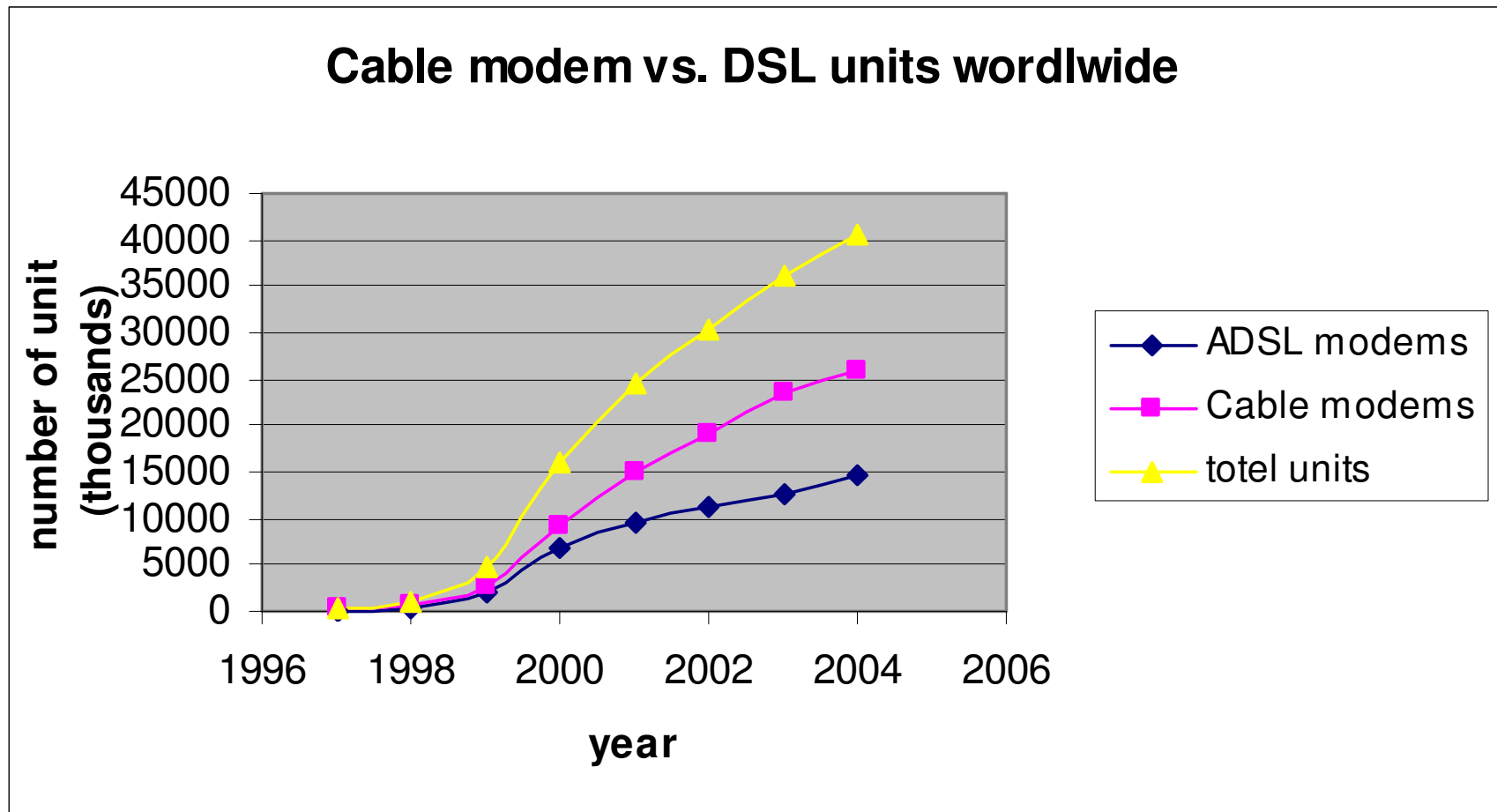


Cable modem vs. xDSL

- DSL
 - Encounters deployment issues
 - Limited bandwidth capability/evolution
 - Prices still high
- Cable
 - First deployments issues solved, technology matured
 - MSOs have realised aggressive 2 ways upgrade/integrated offers
 - Cost effective vs.ADSL



Market projections



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Market trends

- Deregulation : Operators struggling to offer multiservice (video/voice/data)
- Customer : demand for bandwidth will explode (from .5 Mb/s to 10+ Mb/s) : WHY?



Technology trends

- Cost of bandwidth reducing in access:
 - 40 GHz LMDS technology affordable
 - FTTH technology available
- Bandwidth capacity exploding in backbone :
 - WDM transport, high speed routers
- Price of storage exponentially decreasing :
 - VOD / local storage cost effective



Bandwidth demand increase

- Customer has access to higher bit rate with Cable/DSL, and becomes bandwidth demanding
- Applications begin to appear :
 - Multicast events
 - “NOD/VOD” becomes available
 - VOD trials show positive customer reaction
 - Content exchange applications appearing (Napster, etc.); can extend to video



Conclusion

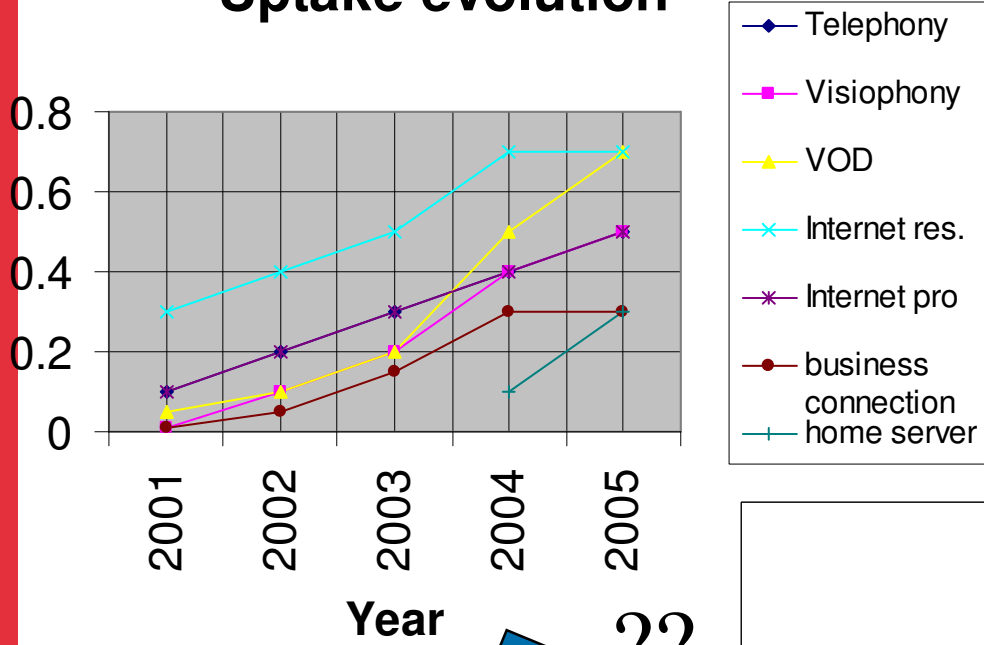
- Technology is ready
- Applications are available
- Customers are enthusiastic



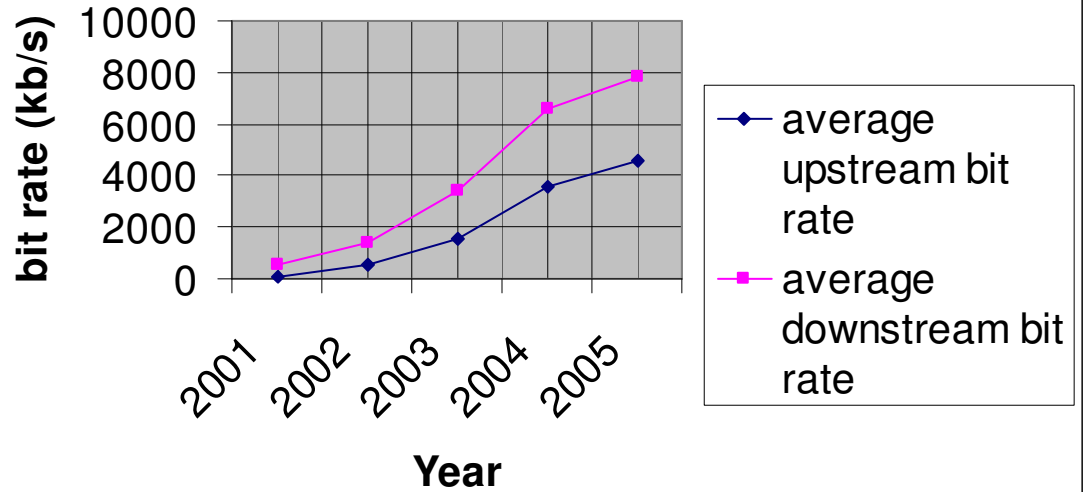
Scenario example

Uptake evolution

Uptake rate



Average bit rate per sub.

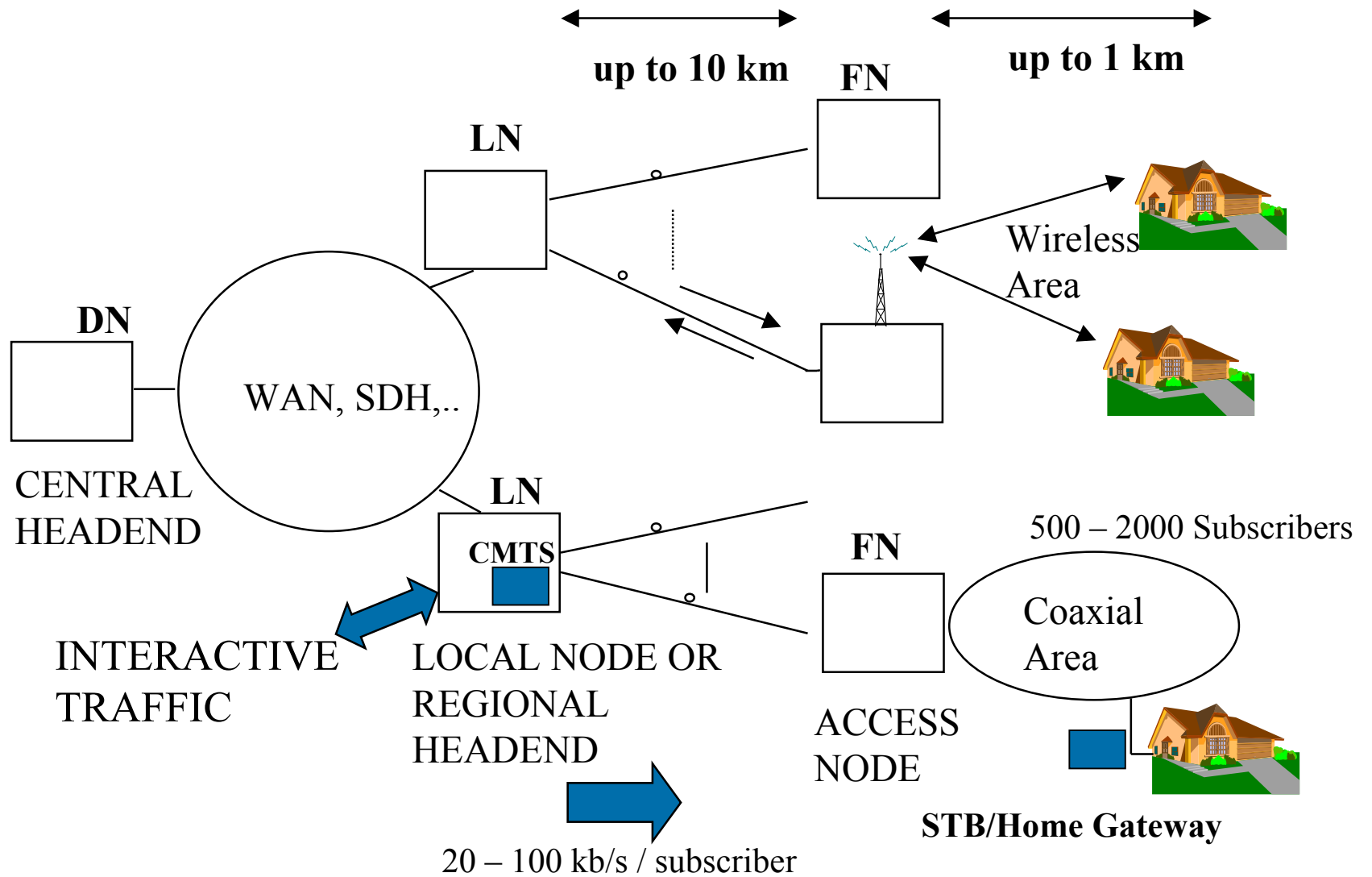


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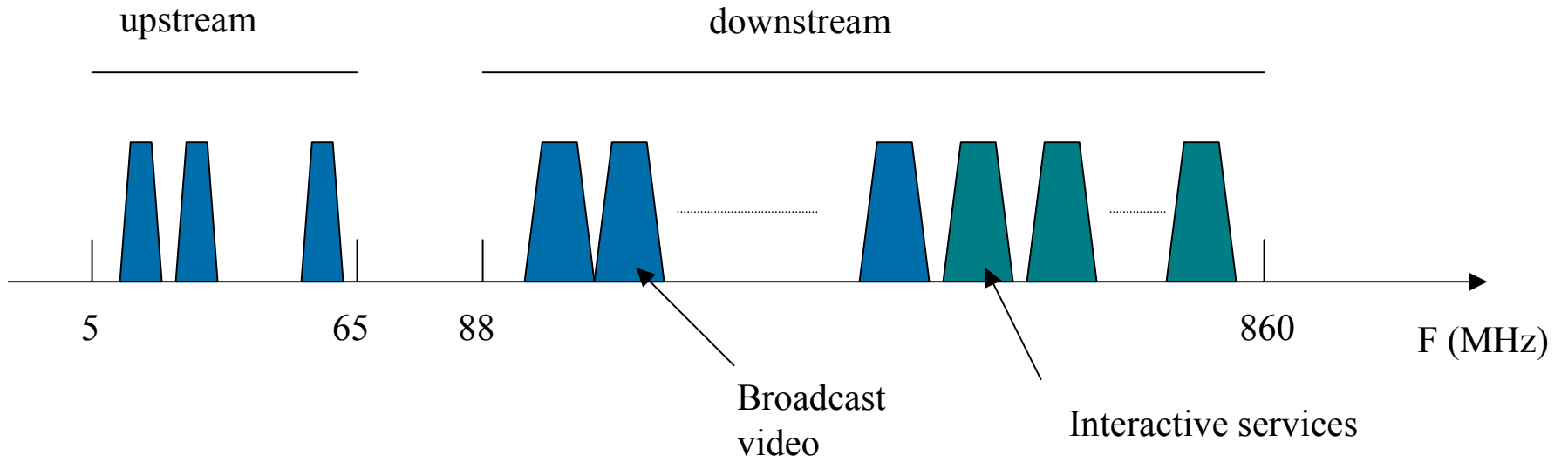
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Network architecture



Spectrum available

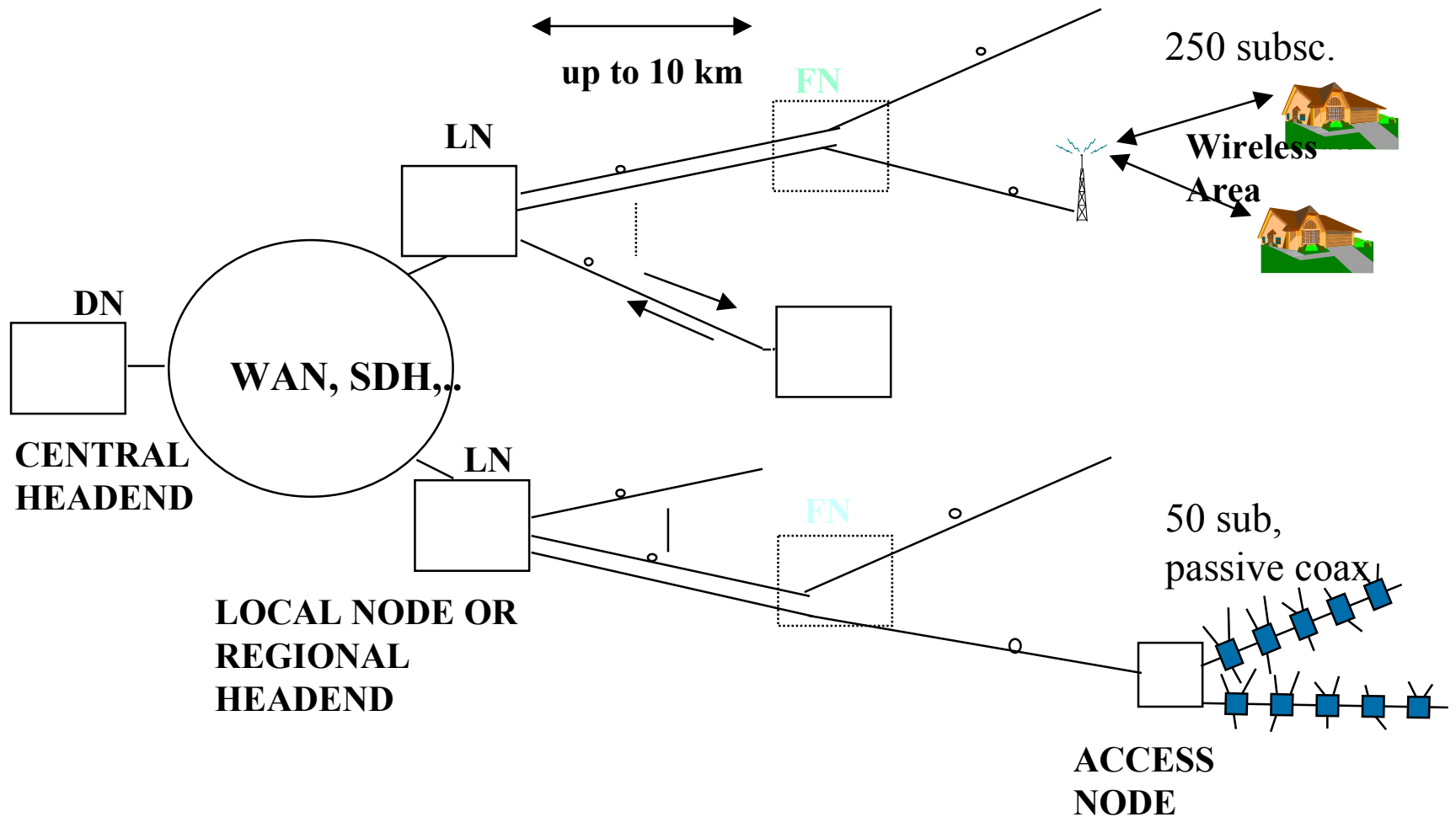


Interactive services

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Evolution for 2Mb/s +

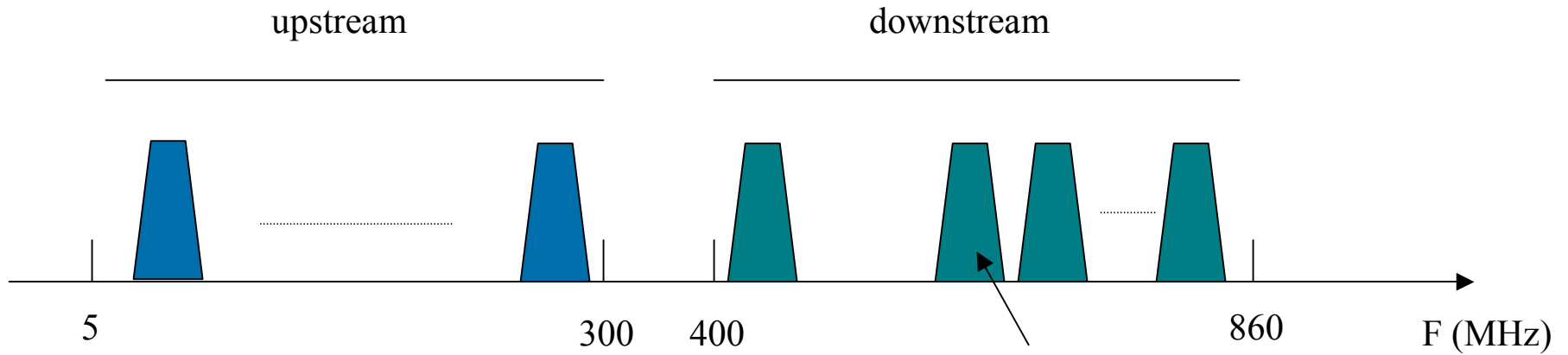
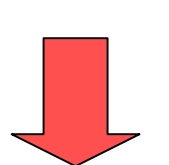
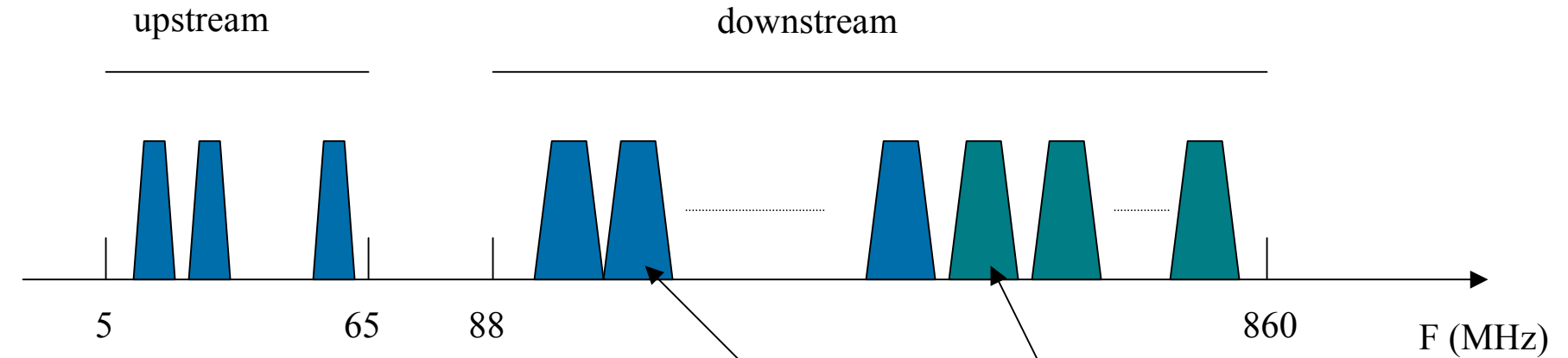


Capacity optimisation

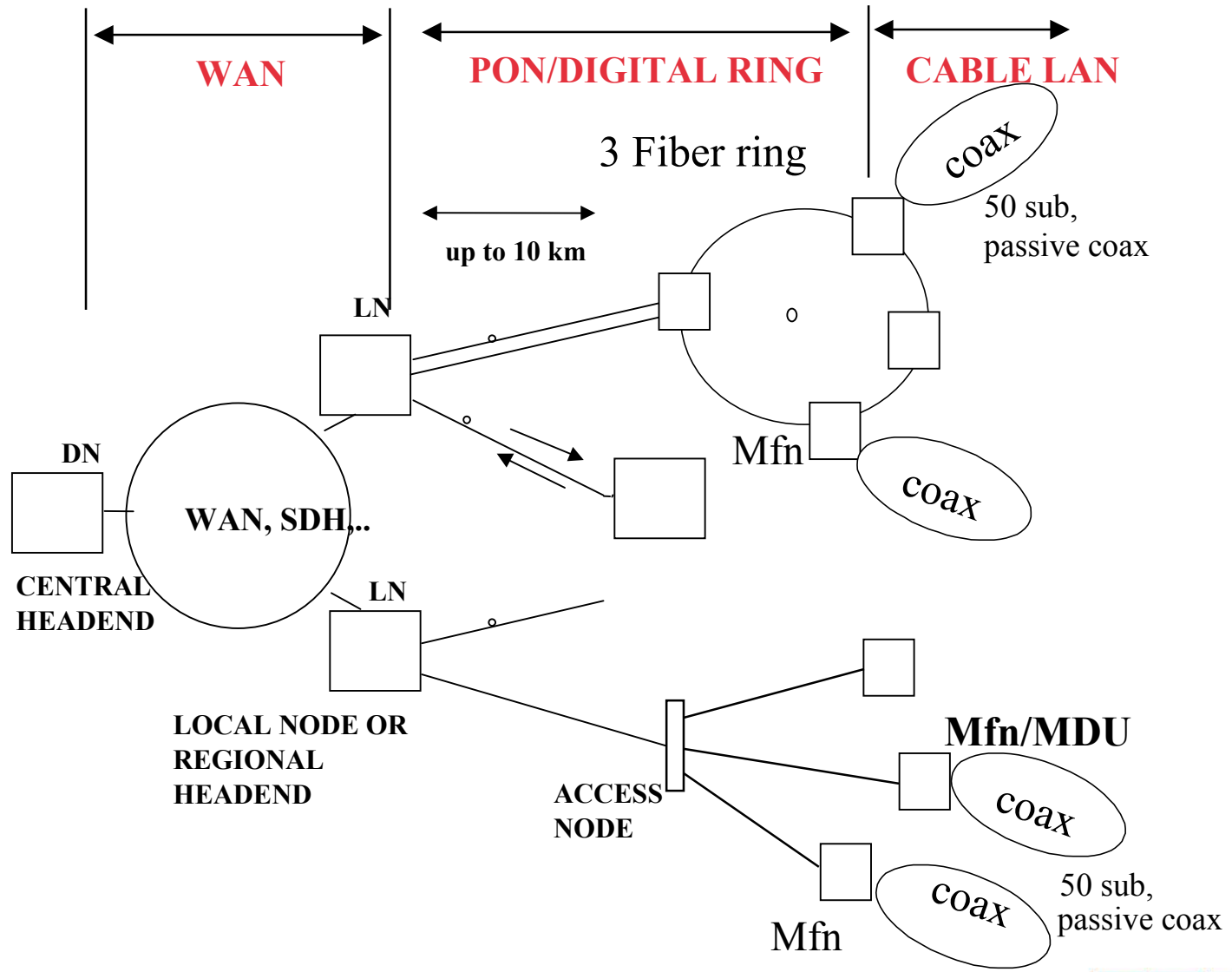
- UPSTREAM :
 - Current single carrier systems :
 - 5-65 MHz
 - Capacity : 2-3 bits/ Hz
 - Multicarrier systems, spread spectrum
 - 4-5 bits/Hz
 - 200-300 Mbps per zone
 - Ex : 500 passings, 20% = 3 Mbps average upstream
 - 125 passings, 70% = 3.5 Mbps av. Upstream !
- DOWNSTREAM : 6-10 Gbps /number of users...



Spectrum allocation evol.



Mini Fiber Node



MfN vs Classical HFC

- Cost / Scalability
- Digitisation of transport network
- Management simplification
- Can support up to 20 Mbps per user (coaxial cells of 30-50 subscribers)

- Doesn't support legacy system
- Change in system paradigm (broadcast-unicast to multicast-unicast)



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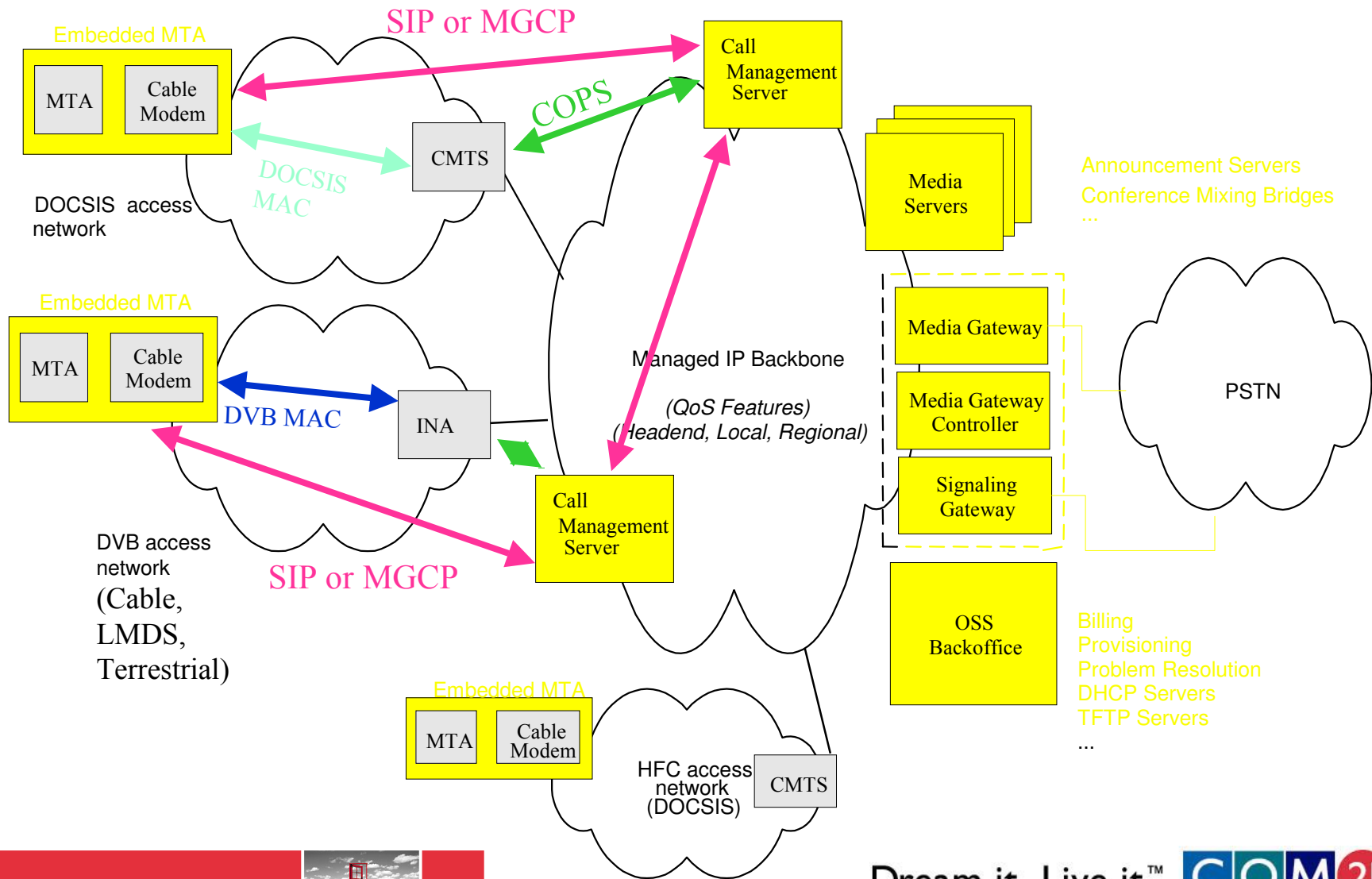


cable telephony

- Network :
 - 500 subscriber areas (no security) offer >99.99% availability
 - Semi secure network (optical) can offer >99.995% availability
- Standard :
 - Protocol architecture fully standardised (including session layers, security and interface) : Packet cable
 - Enhancement with European interface ongoing in ETSI



PACKET CABLE ARCHITECTURE



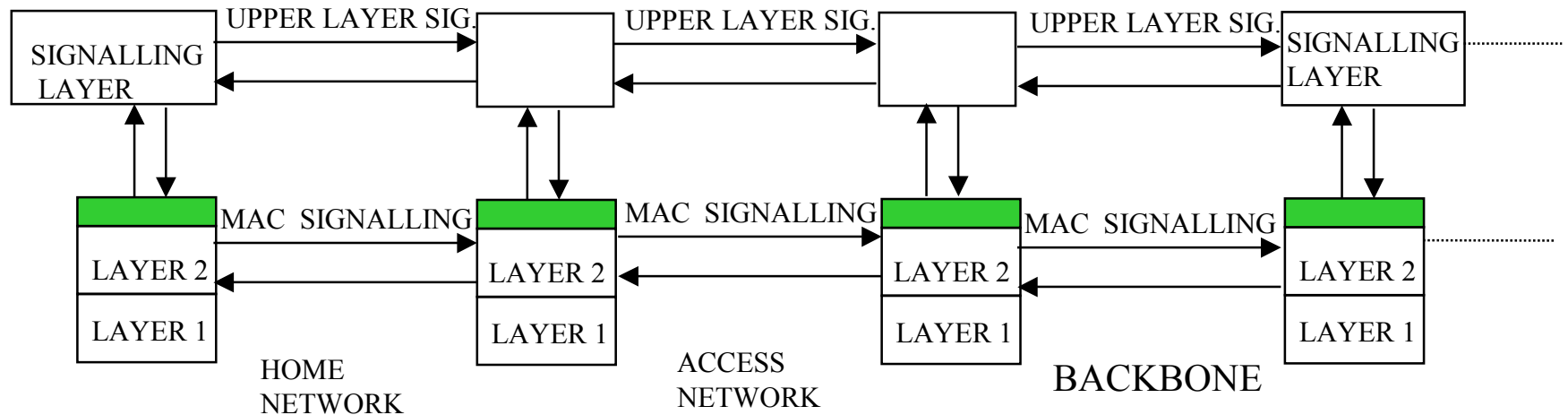
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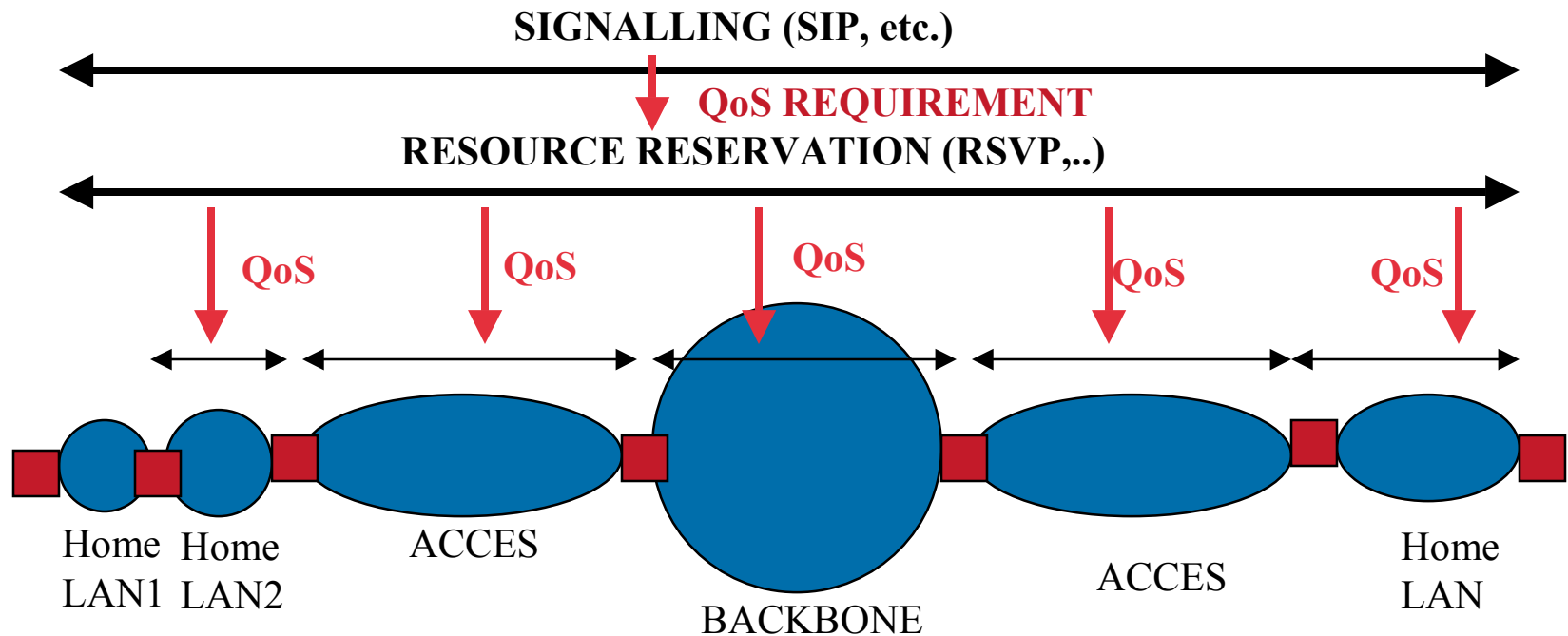


General QoS issue

- **LAYER 3 AND ABOVE COPE ABOUT END TO END TRANSMISSION**
- **LAYER 2 MANAGES THE TRAFFIC IN THE LOCAL NETWORK**
- **AN EXCHANGE OF INFORMATION MUST EXIST BETWEEN LAYERS IN ORDER TO TRANSMIT :**
 - **COMMUNICATION OR SESSION OPENING REQUEST**
 - **REQUIRED QOS INFO + ADDITIONAL FEATURES**



QoS transmission between layers



- QoS Info contained in SDP info in Signalling protocol
- Translated into RSVP flow spec
- Translated into MAC layer QoS requirements (MAC dependant)



Underlying MAC features

- QoS support :
 - **CBR/ VBR / ABR types of QoS support**
- Packet fragmentation support
- Traffic optimisation mechanisms (Haeder compression/suppression)
- Authorisation mechanism necessary (linkage with COPS)
- Complex API to signalling layers



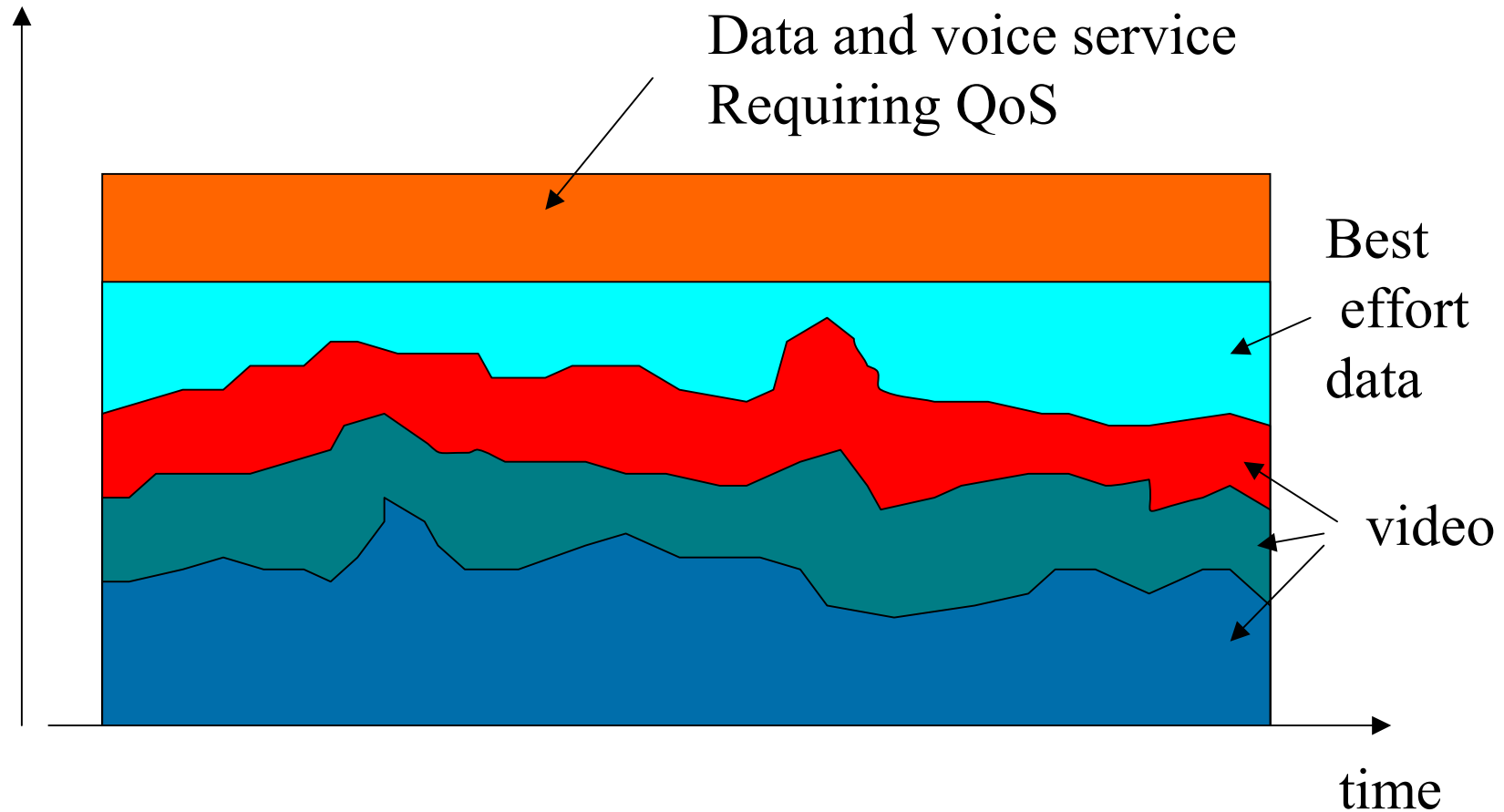
QoS provisioning in RF networks

- DOWNSTREAM :
 - **Use of the DVB mechanisms :**
 - MPEG CLASSICAL TRANSPORT
 - BEST EFFORT DATA FILLING THE HOLES
 - FIX BIT RATE STREAM FOR QoS SERVICES (VOICE,..)
- UPSTREAM :
 - **Fixed bit rate / reservation capabilities**
 - DATA USES RESERVATION ACCESS
 - VOICE USES FIXED BIT RATE (WITH VAD)
 - VIDEO USES FIXED BIT RATE OR RESERVATION



Downstream/upstream

Bit rate



NB : reservation can be used for video with relaxed spec



Other ways to see “QoS”

- **Idea : 10 Mbps + available per subscriber leads to overdimensionning**
 - Fixed traffic pipes per subscriber for unicast traffic
 - Agregated pipes for multicast traffic
 - Simple MAC layer (allocation/deallocation of fixed bit rate pipes)
- **Advantages :**
 - Very simple system
 - Guaranteed QoS



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Security threat

- HFC network is a shared medium :
 - subscriber privacy issue
 - cloning issue
 - jamming issue
- First 2 issues :
 - Establishment of a layer 2 security/authentication : virtual transform of shared medium toward PTP medium
- Third issue :
 - CM disconnect
 - Hardware disconnect



Security layer

- Part of standardised MAC layer (Docsis and DAVIC-DVB)
 - DES for data encryption
 - Diffie-Hellman /RSA for key exchange
 - Hashing for key update / authentication
- **In summary :**
 - Very strong security mechanisms both for encryption/authentication
 - Ensures security/privacy in the cable network
 - Other end to end security defined for VOIP communications



Conclusions for security

- Standardised security layer ensures privacy/authentication
- Intentional Jamming can require hardware disconnect points
- Always on has same issue then ADSL



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Conclusions

- HFC network is suitable for delivery of high reliability services
- HFC is far more scalable than DSL and allows very high bit rate evolution (20 Mbps+)
- Ultimate evolution to fiber always possible..
- QoS can be supported and is fully standardized
- Full subscriber security / authentication is ensured



Conclusions (2) : technology trends

- Migration from Broadcast to multicast-unicast model
- IP as common network layer
- QOS paradigm change from Dynamic QoS and Intserv to more simple model (high bit rate pipes, diffserv, overprovisionning,..)



A surreal image of a red door with a gold handle and a multi-paned window, standing on a paved road that stretches into the distance under a cloudy sky. The door is slightly ajar, and its shadow is cast on the road surface.

Thank You
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